

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER- VII EXAMINATION-SUMMER 2023

Subject Code: 3171917

Date: 28/06/2023

Subject Name: Design of Machine Elements

Time: 10:30 AM TO 01:30 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.
5. PSG/VB Bhandari design data book allowed.

	Marks
Q.1 (a) Define the following terms. (i) Backlash (ii) Pressure angle (iii) Module	03
(b) Find out the numbers of the R5 basic series from 1 to 10.	04
(c) Explain different types of gear tooth failures, causes and their possible remedies.	07
Q.2 (a) Classify different types of bearings.	03
(b) Prove that “The common normal to the tooth profile at the point of contact should always pass through a fixed point, in order to obtain constant velocity ratio”.	04
(c) A pair of spur gears with 20° full-depth involute teeth consists of a 20 teeth pinion meshing with a 41 teeth gear. The module is 3 mm while the face width is 40 mm. The material for pinion as well as gear is steel with an ultimate tensile strength of 600 N/mm ² . The gears are heat treated to a surface hardness of 400 BHN. The pinion rotates at 1450 rpm and the service factor for the application is 1.75. Assume that velocity factor accounts for the dynamic load and the factor of safety is 1.5. Determine the rated power that the gears can transmit. Use the following relations: Load-stress factor $K = 0.16 (\text{BHN}/100)^2$; $C_v = \frac{3}{3+v}$	07
OR	
(c) Define the following terms. (i) Solid length (ii) Free Length (iii) Spring Index (iv) Wahl’s stress factor (v) Surge in spring (vi) Spring rate (vii) Pitch	07
Q.3 (a) Explain the following terms used in bearing design. (i) Rating life of a bearing (ii) Basic static load rating (iii) Sommerfeld Number	03
(b) Discuss the function of a coupling. Give at least three practical applications of it.	04
(c) A safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm ² . It is held on its seat by a close coiled helical spring. The maximum lift of the valve is 10 mm. Design a suitable compression spring of spring index 5 and providing an initial compression of 35 mm. The maximum shear stress in the material of the wire is limited to 500 MPa. The modulus of rigidity for the spring material is 80 kN/mm ² . Calculate: 1. Diameter of the spring wire, 2. Mean coil diameter,	07

3. Number of active turns, and 4. Pitch of the coil.
 Take Wahl's factor, $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$ where, C is the spring index.

OR

- Q.3** (a) Explain flexible coupling and what are its applications? **03**
 (b) Explain Clavarino's and Birnie's equation in detail. **04**
 (c) The shaft and the flange of a marine engine are to be designed for flange coupling, in which the flange is forged on the end of the shaft. The following particulars are to be considered in the design : **07**
- | | |
|---|---------------------------|
| Power of the engine | = 3 MW |
| Speed of the engine | = 100 r.p.m. |
| Permissible shear stress in bolts and shaft | = 60 MPa |
| Number of bolts used | = 8 |
| Pitch circle diameter of bolts | = 1.6 × Diameter of shaft |
- Find :
- | | |
|------------------------------|-----------------------|
| 1. diameter of shaft ; | 2. diameter of bolts; |
| 3. thickness of flange ; and | 4. diameter of flange |

- Q.4** (a) Enlist the objectives of material handling systems. **03**
 (b) Define the following terms: **04**
- | | |
|---|-----------------------------|
| (i) Rating life of rolling contact bearings | (ii) Median life |
| (iii) Equivalent dynamic load | (iv) Reliability of bearing |
- (c) A taper roller bearing has a dynamic load capacity of 26 kN. The desired life for 90% of the bearings is 8000 h and the speed is 300 rpm. Calculate the equivalent radial load that the bearing can carry. **07**

OR

- Q.4** (a) Explain the desirable properties of cylinder materials. State minimum two materials used for it **03**
 (b) Sketch and explain the different types of ends used for pressure vessels. **04**
 (c) Derive Petroff's equation used in bearing design with assumptions made there in. **07**
- Q.5** (a) Give classification of cranes. **03**
 (b) Explain valve gear mechanism in IC Engine. **04**
 (c) Draw the structure diagrams for the following equations of a six speed gear box. **07**
- | | |
|---------------------|----------------------|
| (i) $z = 2(1) 3(2)$ | (ii) $z = 2(3) 3(1)$ |
|---------------------|----------------------|
- Draw the schematic arrangement of the gears for the above equations.

OR

- Q.5** (a) Explain ray and speed diagram used in gear box design. **03**
 (b) Write advantages of wire rope. Draw cross section of 7, 19 and 37 wires in strand of wire rope. **04**
 (c) Discuss stresses in wire rope with usual formulae. **07**
